Preparation, Characterization and Physical Property Studies of Polymer Blend electrolytes

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in

Physics

By

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1. Introduction

Polymers are the chemical compound where molecules are bounded together in a long repeating chain, it contains a long chain organic materials or macromolecules having carbon element is common in their backbone. Polymer electrolytes materials has created an interest of researchers and industries and plays an vital role in the development of advancement in the science and technology as well as industrial applications such as solid state batteries, Li-rechargeable batteries, supercapacitor, fuel cells, photoelectrochemical and electrochromic devices sensors and electro chromic windows, acting as a medium for ion transport between the active components of the device [1-2].

In recent decades use of polymers in the manufacturing, synthetic clothing materials, automobiles, and electrical insulating materials and machine parts has completely covered the daily life as well as industrial applications [3-4]. Polymer electrolyte films despite the practical importance in potential applications could be the reason for researchers diverts their curiosity to study the physical properties of the polymer and polymers are more flexible in their properties subjected to external influence and environmental stability. Polymer derivative such as polyvinylpyrrolidone (polyvinyl chloride (PVC), PVP), poly (methyl methacrylate), poly (ethylene oxide) (PEO), and polyvinylidene fluoride (PVDF) have been highly investigated as a polymer electrolyte [5-8],

PEO is an important semi-crystalline polymer and it is a suitable electrolyte material due to their flexibility, leak-proof, thermal stability, easy film processability and stable ionic conductivity at ambient temperature, these characteristics are significantly preferable for electrolytes used in a separator, but depict is low ionic conductivity[8-10]. To resolve the low ionic conductivity problem, it is necessary to strengthen the efficiency of charge by addition of organic or inorganic alkali, and transition metal salts into PEO as result enhanced the ionic conductivity due to increasing the volume of semi-crystalline[11-12], PEO/PVDF blend film

is a semi-crystalline polymer exhaustively used in manufacturing flexible portable devices due to tremendous physical, chemical, and high mechanical strength, PEO blend with PVDF which enhances the conductivity and also improves the mechanical properties of the complexation of blend film, PEO film is a good compatibility interface between the Li-battery electrodes due to PEO consist of an oxygen bond with an ether functional group [13-14]. Graphene oxide (GO) blend with PEO it is a new strategy to develop a novel material for polymer electrolyte separator due to carbon is one of the distinctive material in research area, their structural properties and hexagonal layered structure provides a more free radical and mobility charge carriers [15-16], which is helpful during the device performance

2. Aims and objective of the present research work

Aims and objective of the present study mentioned in the following way.

1. TO examined the polymer electrolyte blend film PEO/PVDF composite for electrochemical properties
2. To study the properties of blend polymer electrolyte film PEO/GO composite.
3. To know the chemical composition, thermal stability, topological structure, and surface morphology of the prepared blend film, characterized by X-ray diffraction (XRD), Field emission scanning electron microscope (FESEM). Differential scanning calorimeter (DSC), Thermo gravimetric analysis (TGA), and differential thermal analysis (DTA). Fourier transform infrared (FTIR).
4. The prepared blend films analyze to know the electrochemical behavior of the material using a cyclic voltammetry (CV) and Linear sweep voltammetry (LSV).

3. Outcome of the research work

The proposed research work is illustrating the optical, structural, thermal and electrochemical properties of the prepared blend films. The outcome of the research work provides the experimental and theoretical analysis of polymer blend films. The prepared polymer blend films demonstrate that the excellent thermal, and optical properties, and porous structured surface morphology with exhibits ideal electrochemical properties, which suggest that polymer blend films are prominent candidates for various energy and industrial applications.

4. The brief sketch of the proposed thesis work as follows

The proposed research work divided in to six chapters. The first chapter contains brief information of polymer blend films and their properties. The second chapter deals with experimental work and synthesis method. Third to Fifth chapter discussed the obtained results and carried parameters analysis. The sixth chapter focuses on the future scope and opportunity in this field.

Chapter I: Introduction

The first chapter describes the brief information of the polymer electrolyte film and their physical and chemical properties, with their applicability in various daily life and industrial applications. Literature review of the previously reported results.

Chapter II: Experimental method and Characterisation Techniques

The second chapter reports the preparation method of polymer blend film electrolytes and their composites, with characterization techniques to analyze the surface morphology, elemental composition, thermal and optical properties with electrochemical parameters.

Chapter III: Preparation, Characterization, and Electrochemical Properties of PEO/PVDF Blend Films

This chapter presents the preparation and characterization of the PEO/PVDF blend films, in this work prepared PEO/PVDF bend films at various concentration. The morphology and

topological study carried out using Field emission scanning electronic microscopy analysis (FESEM) and Atomic force microscopy (AFM). Thermal properties investigated through Differential scanning calorimeter (DSC), Thermo gravimetric analysis (TGA), and differential thermal analysis (DTA). Electrochemical properties analyzed by cyclic voltammetry (CV) and linear sweep voltammetry (LSV). The CV study reveals the redox pair behavior exhibits the prepared blend films and LSV shows the I-V properties. The obtained results suggesting that the blend film shows good separator for electrochemical and other devices.

Chapter IV: Study the Optical, Structural and Morphology of PEO/GO Composite

In this chapter we have reported on optical, structural and morphology study of PEO/GO composite, GO prepared by hummer's method and PEO/GO composite prepared via solution casting method. The prepared composite optical properties characterized by UV–Visible spectroscopy and Fourier Transform Infrared spectrometer (FT-IR), surface morphology and topology investigated by Atomic force microscopy (AFM) and Field emission scanning electronic microscopy analysis (FESEM). Electrochemical parameters performed by using cyclic voltammetry (CV) and linear sweep voltammetry.

Chapter V: Investigate the Optical, Structural and electrochemical properties of PVC/PMMA/NiO blend films

In this chapter illustrate the optical, structural and electrochemical properties of PVC/PMMA/NiO loaded blend films prepared by solution casting technique, the prepared blend films structural properties and elemental interaction identified by using X-ray diffraction (XRD), Fourier Transform Infrared spectrometer (FT-IR), optical properties examined by UV–Visible spectroscopy, and surface morphology carried out by using Field emission scanning electronic microscopy analysis (FESEM).

Chapter VI: Summary and future scope

These chapters summarize the present study and focuses on the future scope and opportunity.

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List of Journal and proceedings Publications

[1] A paper entitled "Structural and optical band gap of PEO/PVP polymer blend" in AIP Proceedings, May 2018

Basappa M, Yesappa L, Nirnjana M, Ashokkumar S P, Vandana M, Vijeth H, Devendrappa H*

https://doi.org/10.1063/1.5033220

[2] A paper entitled "Morphology, optical band gap and dielectric properties of PEO/PVP polymer blend film" in AIP Proceedings, June 2020.

Basappa M, Yesappa L, Ashokkumar S P, Vijeth H, Devendrappa H*

https://doi.org/10.1063/5.0009198

[3] A paper entitled "Optical properties and ionic conductivity studies of an 8 MeV electron beam irradiated poly (vinylidene fluoride-co-hexafluoropropylene)/LiClO 4 electrolyte film for optoelectronic applications" in RSC Advances, 2018, 8, 15297-15309.

Yesappa, L Niranjana M, Ashokkumar S P, Vijeth H, Vandana M, **Basappa M**, Jishnu Dwivedi, Petwal V C, Sanjeev G, and Devendrappa H.

https://doi.org/10.1039/C8RA00970H

[4] A paper entitled "Effect of electron beam irradiation on structure, morphology, and optical properties of PVDF- HFP/PEO blend polymer electrolyte films" in Journal of Radioanalytical and Nuclear Chemistry

Yesappa L, Ashokkumar S P, Vijeth H, Vandana M, **Basappa M,** Ganesh S, and Devendrappa H.

https://doi.org/10.1007/s10967-019-06466-0L

[5] A paper entitled "Structure, dielectric, thermal and I-V studies of electron beam irradiated PVDF-HFP/LiClO4 electrolyte film" AIP Conference Proceedings 1953, 050059 (2018);

Yesappa, L Niranjana M, Ashokkumar S P, Vijeth H, Vandana M, **Basappa M,** Ganesh S, and Devendrappa H.

DOI: 10.1063/1.5032714.

[6] A paper entitled "Electron Beam irradiation effect on Structure, Morphology and, Optical Properties PVDF HFP/PEO Blend polymer electrolyte films" in Matter: Int. J. Scie and Tech Conference Proceedings 2018.

Yesappa, L Niranjana M, Ashokkumar S P, Vijeth H, Vandana M, **Basappa M**, Jishnu Dwivedi, Petwal V C, Sanjeev G, and Devendrappa H.

[7] A paper entitled "Structure, Morphology and Optical Properties of CuO nano particles immersed PANI/Li Composite"

Yesappa L, Ashokkumar S P, Vijeth H, , Veeresh S, Nagaraju Y S Ganesha H, **Basappa M,** Niranjana M, Devendrappa H*

https://doi.org/10.1063/5.0009090

Manuscript communicated

[1] A paper entitled "Preparation, characterization, and electrochemical properties blend films PEO/PVDF to Polymer plastics technology and materials journal.

[2] A paper entitled "Study the Optical, Structural and Morphology of Poly Ethylene oxide Graphene Oxide Composite"

Conferences and Workshops

1. Participated & presented an article entitled "Structural and optical band gap of PEO/PVP polymer blend" in ICC-2017 Organized by Govt. Engineering College, Bikaner-Rajasthan during 24-25 November 2017.

2. Participated & presented an article entitled “Morphology, optical band gap and dielectric properties of PEO/PVP polymer blend film” in ICPN-2019 Organized by department of Physics Mangalore University during 19-21 September 2019.

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